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(30)Priority

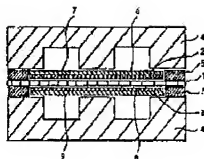
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(54) SOLID HIGHPOLYMER FUEL CELL

(57)Abstract:

PURPOSE: To greatly enhance the activity of an air electrode so as to significantly enhance the performance of a fuel cell having a hydrogen electrode and an air electrode provided on both sides of a film of solid highpolymer electrolyte by making the water repellency of the hydrogen electrode higher than that of the air electrode.

CONSTITUTION: A fuel cell comprises a hydrogen electrode 2 consisting of a catalyst layer 6 and a gas diffusion layer 7 with a film 1 of solid highpolymer electrolyte sandwiched therebetween, an oxygen electrode 3 consisting of a catalyst layer 8 and a gas diffusion layer 9, and a current collector 4 provided with several gas supply channels, and the end portion of each electrode 2, 3 is sealed by gas seals 5 to prevent gas leaks. Each of the catalyst layers is obtained by mixing and molding of an active component, a carbon carrier, a proton conductor and a water-repellent binding agent while the water repellency of the hydrogen electrode 2 is made higher than that of the oxygen electrode 3. Therefore, at the hydrogen electrode, electrode reactions in pores are accelerated, whereas at the oxygen electrode water is allowed to migrate easily and can readily be drained out of the system; so the gas diffusion properties of both of the electrodes are improved, resulting in enhancement of cell performance.



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## CLAIMS

### [Claim(s)]

[Claim 1] The solid-state macromolecule type fuel cell which consists of electronic-conduction objects which served both as the catalyst bed and gaseous diffusion layer which are characterized by providing the following, and is characterized by the water repellence of the catalyst bed by the side of this hydrogen pole being higher than the water repellence of the catalyst bed by the side of this oxygen pole Solid-state polyelectrolyte film The hydrogen pole and oxygen pole which are a gas diffusion electrode prepared so that the electrolyte film might be inserted A means to supply hydrogen content gas and oxygen content gas to this hydrogen pole and this oxygen pole is provided, and this gas diffusion electrode is carbon support. The active ingredient, the proton conductor, and the water-repellent binder which were supported by it

[Claim 2] It is the solid-state macromolecule type fuel cell according to claim 1 characterized by the water repellence of the catalyst bed of a hydrogen pole and the catalyst bed of an oxygen pole being lower than each gaseous diffusion layer side a solid-state polyelectrolyte film side, and the water repellence by the side of the solid-state polyelectrolyte film of the catalyst bed of an oxygen pole being lower than the water repellence by the side of the solid-state polyelectrolyte film of the catalyst bed of a hydrogen pole.

[Claim 3] The amount of a water-repellent binder is the solid-state macromolecule type fuel cell according to claim 1 to which the amount of a hydrogen pole is characterized [ in / the difference / about an oxygen pole, are 10 - 40 % of the weight, are 20 - 50 % of the weight about a hydrogen pole, and ] by many / 10% of the weight or more / things rather than the amount of an oxygen pole to the whole quantity of each catalyst bed of a hydrogen pole and an oxygen pole.

[Claim 4] The amount of a water-repellent binder is the solid-state macromolecule type fuel cell according to claim 1 to which the amount of a hydrogen pole is characterized [ in / the difference / about an oxygen pole, are 10 - 30 % of the weight, are 20 - 40 % of the weight about a hydrogen pole, and ] by many / 10% of the weight or more / things rather than the amount of an oxygen pole to the whole quantity of each catalyst bed of a hydrogen pole and an oxygen pole.

[Claim 5] The amount of the water-repellent binder of the catalyst bed by the side of the solid-state polyelectrolyte film of a hydrogen pole is a solid-state macromolecule type fuel cell according to claim 2 characterized by many [ 10% of the weight or more ] things in the difference rather than it by the side of the solid-state polyelectrolyte film of an oxygen pole.

[Claim 6] The solid-state macromolecule type fuel cell according to claim 1 characterized by the catalyst bed of a hydrogen pole having porosity smaller than the porosity of the catalyst bed of an oxygen pole.

[Claim 7] The solid-state macromolecule type fuel cell according to claim 3 which porosity is 35 - 60% about the catalyst bed of a hydrogen pole, and is characterized by being 40 - 65% about the catalyst bed of an oxygen pole.

[Claim 8] The catalyst bed of an oxygen pole and the catalyst bed of a hydrogen pole are a solid-state macromolecule type fuel cell according to claim 1 which is a multilayer more than two-layer, and is characterized by water repellence being higher a gaseous diffusion layer side in each catalyst bed, respectively.

[Claim 9] The solid-state macromolecule type fuel cell according to claim 1 to which a solid-state polyelectrolyte film is characterized by the bird clapper from perfluoro sulfonic acid type resin or perfluoro carboxylic acid type resin.

[Claim 10] An active ingredient is a solid-state macromolecule type fuel cell according to claim 1 characterized by the bird clapper from a platinum metal.

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## DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] this invention relates to a solid-state macromolecule type fuel cell, especially relates to a solid-state polyelectrolyte type hydrogen-oxygen fuel cell.

[0002]

[Description of the Prior Art] A solid-state macromolecule type fuel cell possesses two electrodes which generally sandwich two charge collectors, solid-state polyelectrolyte films (only henceforth an "electrolyte film"), and electrolyte films, and a means to supply the hydrogen as fuel, and the oxygen as an oxidizer. Two electrodes have the catalyst bed which consisted of a catalytic activity component, support which supports this catalytic activity component, an ion (proton) conductor of the same solid-state macromolecule as the above-mentioned electrolyte, and a binder which hardens these. two electrodes are with a hydrogen pole and an oxygen pole, and the electrochemical reaction which boils, respectively and can be set is as follows

[0003] On a hydrogen pole, a hydrogen-content child is ionized, it becomes a proton, and an electron is emitted.

[0004] A proton conducts the ion conductor in an electrode, reaches an electrolyte film, passes through the inside of an electrolyte film further, and moves to the oxygen pole of an opposite side. On the other hand, the emitted electron moves to an oxygen pole through an external circuit. On the oxygen pole, a proton combines with the electron emitted from the hydrogen pole, and water is generated.

[0005] The reaction process of the above-mentioned fuel cell mainly consists of the following four stages.

[0006] (A) Conduction in the interior of the reaction on the front face of a catalyst in the diffusion to the catalyst front face of hydrogen and oxygen, (B) hydrogen pole, and an oxygen pole, the interior of two poles of the (C) proton, and an electrolyte, and discharge of (D) water.

[0007] The grade of diffusion of the fuel gas in each stage and the grade of a reaction rate influence cell output characteristics greatly.

[0008] In the stage of the above (A), it is effective to perform efficiently supply on a catalyst front face and diffusion of fuel, and using the carbon plate which has a rectangle slot which is indicated by a wave type charge collector as shown in drawing 1 of JP,60-35472,A, JP,3-102774,A, or JP,2-86071,A is proposed. If the side which has the slot of the carbon plate which has these wave type charge collectors and rectangle slots is contacted to an electrode, space will be generated in the contact surface and fuel will be spread on an electrode front face through this space. In the solid-state macromolecule type fuel cell, the usually above structures are adopted and a certain amount of output is discovered.

[0009] In an oxygen pole interface, a reaction with oxygen progresses by the interface of an electrolyte film and an oxygen pole, water is generated, the water screen is especially formed with high current density, and the so-called flooding phenomenon produces the proton which has passed the electrolyte film. The contacting efficiency of the oxygen gas and the catalyst which have diffused the inside of an electrode for this water screen falls, reduction in power density becomes easy to take place, and a cell performance destabilizes. It is easy to produce especially this flooding phenomenon in the interface of an oxygen pole and an electrolyte. Then, it is necessary to remove this generation water out of a system.

[0010] Therefore, U.S. patent 4,643,957th It has proposed controlling the water repellence of an electrode in a number and canceling a flooding phenomenon.

[0011]

[Problem(s) to be Solved by the Invention] The purpose of this invention is offering the solid-state macromolecule type fuel cell which is made to promote movement of the proton generated from a hydrogen-content child on the hydrogen pole, and has the electrode structure of accelerating the

oxidation-reduction reaction produced in the interface of an electrode and an electrolyte film while preventing the flooding of water on the oxygen pole and improving the contacting efficiency of an electrode catalyst bed and gas, in order to diffuse the gas of a hydrogen pole and an oxygen pole at high efficiency. [0012]

[Means for Solving the Problem] The hydrogen pole and oxygen pole which are a gas diffusion electrode prepared so that this invention might sandwich a solid-state polyelectrolyte film and its electrolyte. A means to supply hydrogen content gas and oxygen content gas to a hydrogen pole and an oxygen pole, respectively is provided. this gas diffusion electrode It consists of electronic-conduction objects which served both as the catalyst bed and gaseous diffusion layer which consist of carbon support, an active ingredient supported by it, and a proton conductor and a water-repellent binder, and the water repellence of this catalyst bed is the solid-state macromolecule type fuel cell characterized by being higher than an oxygen pole side a hydrogen pole side.

[0013] According to this invention, the cell performance of a solid-state macromolecule type fuel cell can be raised by controlling the water repellence of the catalyst bed of each electrode under a certain specific condition.

[0014] According to an example of this invention, the electrolyte film of the water repellence of a hydrogen pole is lower than a gaseous diffusion layer, and the water repellence in the catalyst bed of an oxygen pole is lower than a gaseous diffusion layer an electrolyte film side similarly, and the direction of the water repellence [ water repellence / by the side of the electrolyte film of the catalyst bed of a hydrogen pole ] by the side of the electrolyte film of the catalyst bed of an oxygen pole moreover is a low. In addition, on both an oxygen pole and a hydrogen pole, although it is good as for one layer in a catalyst bed, the multilayer more than two-layer is sufficient.

[0015] According to this invention, the catalyst bed of the two poles of a hydrogen pole and an oxygen pole consists of carbon support, the active ingredient (catalyst) supported by it and a proton conductor, and a water-repellent binder. As for an active ingredient, it is desirable to be chosen out of platinum or a platinum metal, for example, a rhodium, a ruthenium, palladium, and iridium, and even if the quality of the material of a proton conductor is the same as a solid-state polyelectrolyte, they may differ again. Moreover, the graphites fluoride expressed with fluororesins, such as a polytetrafluoroethylene (PTFE), or  $(CF)_n$  and those mixture are suitable for a water-repellent binder.

[0016] Generally the electrolyte used by this invention is a membranous gestalt, and the solid-state macromolecule resins like perfluoro sulfonic acid type resin and perfluoro carboxylic acid type resin of the quality of the material generally used are desirable.

[0017] The fundamental cell structure of this invention is shown in drawing 1 . The fuel cell consists of the solid-state polyelectrolyte film 1, the hydrogen pole 2 and the oxygen pole 3 established in the both sides, and a charge collector 4 formed in the outside. Some gas supply slots are established in the charge collector 4. Two charge collectors 4 are opposed, the electrolyte film 1 and electrodes 2 and 3 are pinched between them, and a gas seal 5 protects the leakage of gas. Drawing 2 is the electrolyte film of drawing 1 , and the enlarged view of an electrode, and shows the arrangement relation between the hydrogen pole 2 of this invention, the oxygen pole 3, and the solid-state polyelectrolyte film 1. The hydrogen pole 2 consists of a catalyst bed 6 and a gaseous diffusion layer (it acts as an electronic-conduction object) 7, and the oxygen pole 3 consists of a catalyst bed 8 and a gaseous diffusion layer (it acts as an electronic-conduction object) 9. A gaseous diffusion layer can cast, sinter and obtain a carbon fiber. The electrolyte film 1, a catalyst bed 6, the gaseous diffusion layer 7 and a catalyst bed 8, and the gaseous diffusion layer 9 are arranged as mentioned above, and pressurization unification is carried out. Each catalyst bed mixes an active ingredient, carbon support, a proton conductor, and a water-repellent binder, casts and is obtained. An important thing is that the water repellence of a hydrogen pole is higher than the water repellence of an oxygen pole.

[0018] As mentioned above, while the wettability of a catalyst bed is controlled by the hydrogen pole and this invention promotes the electrode reaction within the pore of an electrode by raising the water repellence of a hydrogen pole rather than an oxygen pole. Since the oxygen pole of a hydrophilic property is stronger, it becomes easy easily from a bird clapper to discharge [ of moisture ] movement of moisture outside a system, and it is to have raised the cell performance and have stabilized it by improving the gaseous diffusion nature of two poles.

[0019] It may add in each catalyst bed and the binder in which a water-repellent grade differs from the case where it carries out by changing the amount of a water-repellent binder and adding to a catalyst bed

may be carried out to water-repellent control. It is the feature that water repellence is controllable, without the former changing the pore structure of a catalyst bed. Although the latter changes some pore structures of a catalyst bed, it is a simple and practical method. Although the fluororesins [ , such as a polytetrafluoroethylene (PTFE), ] and graphite fluoride represented with (CF)  $n$ , those mixture, etc. are usable as described above, it cannot include in a water-repellent binder so much from it being a resistor electrically. For example, when a water-repellent binder is a polytetrafluoroethylene, the amount is 10 - 30 % of the weight preferably ten to 40% of the weight about an oxygen pole to the whole quantity of each catalyst bed of a hydrogen pole and an oxygen pole, and is 20 - 40 % of the weight preferably 20 to 50% of the weight about a hydrogen pole, and there are more the amounts of a hydrogen pole 10% of the weight or more in the difference than the amount of an oxygen pole. It is the range of an amount with the same said of other water-repellent binders. Although the ion exchange group of a proton conductor is hydrophilicity-like, it is not hydrophilicity-like [ other portions ] not necessarily. It changes with material. Therefore, although the addition effect of a proton conductor is not so remarkable as the case of a water repellent, if an addition increases, a hydrophilic group will increase and a hydrophilic property will increase certainly. Thus, it is also possible to suppress the water repellence of the catalyst bed of an oxygen pole lower than that of the catalyst bed of a hydrogen pole.

[0020] The ion conductor for adding to a catalyst bed and aiming at expansion of an effective reaction surface area has especially desirable high perfluoro sulfonic acid type resin or perfluoro carboxylic acid type resin of chemical stability etc. because of the severe service condition of touching oxidization and reducing atmosphere.

[0021] In order to prepare an electrode, the method of application is suitable. This method mixes the carbon support catalyst which supported the active ingredient beforehand, a proton conductor, and a water-repellent binder, and consists of applying to the electronic-conduction object which is a gaseous diffusion layer. If an electrode is prepared by this method, as mentioned above, the water repellence of an electrode prepares the addition of a water-repellent binder, and can select it arbitrarily. Moreover, in order to form a water-repellent concentration gradient, a catalyst and a proton conductor are mixed, it applies on an electronic-conduction object, and the catalyst bed is formed. There is a method of sinking into the front face of the catalyst bed the solution which distributed the water-repellent binder, or the method of carrying out the laminating of the bilayer electrode from which water repellence differs, and unifying. Manufacture of porosity is possible by changing the catalyst support, the water repellents, and those amounts of a different particle diameter.

[0022] The catalyst bed which supported noble metals beforehand is formed in manufacture of a catalyst component as a thin film in the shape of an electronic-conduction object. Furthermore, the method of newly adding a noble-metals component from the front face is also good. It can be made to deposit as the method in sinking [ of a noble-metals compound solution ] in, plating, vacuum evaporation, ion implantation, etc.

[0023]

[Function] In a fuel cell, in order to promote dryness prevention of an electrolyte film and movement of a proton in a hydrogen pole, moisture is added. When the water repellence of a catalyst bed is not enough, catalyst pore is covered by the moisture and diffusion of gas is checked. Moreover, since the movement magnitude of the moisture which moves into an electrolyte film will become inadequate and an electrolyte film will be in dryness when the water repellence of an oxygen pole is higher than a hydrogen pole, movement of a proton is checked, and a cell performance falls, without electrode reaction advancing. On the other hand, it is necessary to promote discharge out of the system of the water of hydration which accompanies a proton, and the moisture generated by electrode reaction, and to raise the diffusibility of oxygen gas required for electrode reaction simultaneously on the oxygen pole.

[0024] In this invention, by making the water repellence of a hydrogen pole higher than an oxygen pole, the wettability of a hydrogen pole catalyst bed is controlled and excessive moisture was discharged out of the hydrogen pole catalyst bed. Therefore, supply of sufficient moisture for an electrolyte film came to be carried out, and move resistance of a proton was reduced, and discharge of the water from an oxygen pole was promoted, and the flooding by water and generation water which are supplied from an electrolyte film is prevented. Consequently, expansion and stable maintenance of effective reaction area are attained, and the cell of high power density and a stable performance can be realized. However, making the water repellence of a hydrogen pole higher than an oxygen pole differs from the usual hydrogen-oxygen fuel cell. That is, hydrogen is superior to oxygen also in any of electrochemical reaction activity and diffusibility. Therefore, it

becomes the gaseous diffusion nature of an oxygen pole, and a technical problem important for performance maintenance of reservation of a reaction surface area, and it is devised so that the water repellence of an oxygen pole may be made high. However, in the solid-state macromolecule type hydrogen-oxygen fuel cell, the operation effect of this invention which is contrary to the conventional common sense was accepted. However, since the lowness of the diffusibility of oxygen does not change even if there is peculiarity of a solid-state macromolecule type fuel cell, the water repellence of an oxygen pole cannot be made extremely low. There is a limitation naturally. When a water repellent is PTFE, the minimum is 10 % of the weight.

[0025] The water repellence of a hydrogen pole catalyst bed is made for the solid-state polyelectrolyte film side to become low rather than a gaseous diffusion layer side. When the water repellence of an oxygen pole catalyst bed is made still lower than the solid-state polyelectrolyte side of a hydrogen pole catalyst bed and it was made for the water repellence of the gaseous diffusion layer by the side of an oxygen pole to turn into high water repellence from an electrode catalyst bed further. While promoting the flow of the water from a hydrogen pole to an air pole, permeation of the water to a gaseous diffusion layer can be prevented, and a firedamp migration can be made easy. Moreover, the concentration of the proton conductor added to an electrode catalyst bed or the porosity of an electrode catalyst bed can adjust the water repellence or hydrophilic property of an electrode similarly. Since molecule size is small and the hydrogen supplied to a hydrogen pole has good diffusion when the porosity of an electrode catalyst is explained, diffusion of gas is easy in porosity being lower than an oxygen pole, and there is no supply of gas with a bird clapper badly. It is important to raise porosity, since the diffusibility of oxygen is low and reactivity is also low, and to supply sufficient amount on the oxygen pole. However, there is a proper range in the porosity of an electrode, if porosity is too low, the diffusibility of gas will fall and electrode reaction will not advance. If porosity is too high, the electric resistance of an electrode catalyst bed will become high, further, it is easy to dry a catalyst bed with distributed gas, maintenance of the effective area of a reaction place becomes difficult, and an electrode performance stops moreover, being discovered. Therefore, although according to the result of examination there is a proper range in porosity, and about 40 – 65% has 35 – 60 good% on the oxygen pole, and it is effective on the hydrogen pole after that the direction which made the porosity of an oxygen pole higher than a hydrogen pole 5% or more balances [ water ] between two poles, in order to raise an electrode performance, 10% or more is suitable.

[0026] Hereafter, although an example explains this invention, it is not limited to this.

[0027]

[Example]

The electrode catalyst which supported platinum to example 1 carbon powder was fully kneaded with the perfluoro sulfonic-acid system cation exchange resin (the product made from Aldrich Chemical, Nafion liquid) which is a proton conductor, and the drainage system suspension of PTFE, the paste was prepared, and it applied to about 100 micrometers of pore size and the carbon paper with a thickness of 100 micrometers which are an electronic-conduction object (gaseous diffusion layer). It was dried at 80 degrees C and the electrode was obtained. The above-mentioned electronic-conduction object is the drainage system suspension of PTFE to a carbon paper PTFE coverage 12 mg/cm<sup>2</sup> It applied at a rate, and calcinated and obtained at 350 degrees C. Composition of a hydrogen pole was set to amount of platinum 0.3 mg/cm<sup>2</sup>, 30 % of the weight of proton conductors, and 30 % of the weight of PTFE. Composition of an oxygen pole was set to 2, the 20 % of the weight of the same proton conductors as the above, and 20 % of the weight of PTFE the amount of platinum of 0.3mg/cm.

[0028] The electrode which made the hydrogen pole and the oxygen pole the same composition as amount of platinum 0.3 mg/cm<sup>2</sup>, 20 % of the weight of proton conductors, and 20 % of the weight of PTFE for this invention and comparison was created as a conventional article for comparison.

[0029] Adhesion on the solid-state polyelectrolyte film of the above electrode was performed by hot pressing. In an electrolyte film, it is Du Pont. Shrine make Nafion 117 It used. It is what allotted the hydrogen pole and the oxygen pole to the both sides of an electrolyte film 100 kg/cm<sup>2</sup> It pressed at the temperature of 120 degrees C with the pressure for 15 minutes. The electrode produced as mentioned above was included in the measurement cell, and the current density-voltage characteristic was measured on condition that 80 degrees C and one atmospheric pressure. The result is shown in drawing 3 .

[0030] the electrode 11 of a conventional type — limiting current density — 200 mA/cm<sup>2</sup> it is — things are shown — receiving — the limiting current density of the electrode 10 of this invention — 450mA/cm<sup>2</sup> It exceeded. Thus, by making the water repellence of a hydrogen pole higher than an oxygen pole, the cell

performance was able to be improved sharply.

[0031] The manufacture method of example 2 electrode was as follows. The catalyst which supported platinum to carbon support, and the perfluoro carboxylic acid type resin which is a proton conductor were fully kneaded, and the catalyst paste was obtained. This paste was rolled out by the roll press, and two or more sheets were obtained. The PTFE drainage system suspension whose PTFE concentration is 20 % of the weight was infiltrated into these sheets, it dried at 80 degrees C, and the sheet-like catalyst bed was obtained. Next, the PTFE drainage system suspension which changed PTFE concentration into the sheet-like catalyst bed was infiltrated, and it dried at 80 degrees C. Furthermore, the PTFE drainage system suspension which changed another PTFE concentration was infiltrated, and it dried at 80 degrees C. Thus, the electrode to which a hydrogen pole and an oxygen pole have the concentration gradient of a water repellent in the thickness direction of a catalyst bed was created. The water-repellent concentration of the catalyst bed of a hydrogen pole has the concentration gradient so that it may become 40 % of the weight by the gaseous diffusion layer side 20% of the weight by the electrolyte side. It had the concentration gradient so that the water-repellent concentration of the catalyst bed of an oxygen pole might become by the electrolyte film side and might become 30 % of the weight by the gaseous diffusion side 10% of the weight. There was at least 10 % of the weight of differences of the water-repellent concentration of a hydrogen pole and an oxygen pole.

[0032] The obtained sheet-like catalyst bed was united with the carbon paper by the roll press, and the electrode was obtained. Hereafter, the same conditions as an example 1 compared. The obtained result is shown in drawing 4. The curve 12 the cell performance of this invention indicates the cell performance of this invention to be to limiting current density is 500 mA/cm<sup>2</sup>. It exceeded. Thus, by giving a water-repellent concentration gradient into the catalyst bed of a hydrogen pole and each oxygen pole showed that a cell performance improved sharply.

[0033] As it was three or less example, the electrode from which porosity differs in each catalyst bed of a hydrogen pole and an oxygen pole between an electronic-conduction object, i.e., gaseous diffusion layer, side and an electrolyte side was produced. Two poles were made two-layer, respectively. The electronic-conduction object side of the catalyst bed of the hydrogen pole kneaded the particle of the carbon support of 3 micrometers of mean particle diameters which \*\*\*\*(ed) platinum, 30% of the weight of ion exchange resin (perfluoro sulfonic acid type resin), and 40% of the weight of PTFE, and obtained the paste. This paste was applied to the carbon paper and it dried at 80 degrees C. Furthermore, the paste which kneaded and obtained the particle of the carbon support of 1 micrometer of mean particle diameters which supported platinum, 30% of the weight of ion exchange resin, and 40 % of the weight of 40% of the weight of PTFE was applied on it, and it dried at 80 degrees C. Thus, the hydrogen pole which porosity made 40% by the electrolyte film side 50% by the electronic-conduction object side was obtained. The catalyst bed of an oxygen pole applies to a carbon paper the paste which kneaded and obtained the particle of the carbon support of 6 micrometers of mean particle diameters which supported the platinum catalyst, 20% of the weight of ion exchange resin (perfluoro sulfonic acid type resin), and 30% of the weight of PTFE. The paste which dried, obtained at 80 degrees C, and kneaded and obtained further the particle of the carbon support of 3 micrometers of mean particle diameters which supported the platinum catalyst on it, 20% of the weight of the same ion exchange resin, and 30% of the weight of PTFE was applied to the carbon paper, and it dried and obtained at 80 degrees C. Consequently, the porosity by the side of an electronic-conduction object of the porosity by the side of an electrolyte film was 60% 50%. It compared on the same conditions as an example 1. The obtained result is shown in drawing 5. Limiting current density is 500 mA/cm<sup>2</sup> by the curve 13 which shows the cell performance of this invention. It turns out that it exceeds. Thus, by making the porosity of an oxygen pole higher than a hydrogen pole, the cell performance was able to be improved sharply.

[0034] It is possible to be able to improve more sharply than the conventional thing the activity of the oxygen pole of a solid-state macromolecule type fuel cell and a hydrogen pole by this invention, and to obtain about 2 to 3 times as many power density as this so that clearly from the above result.

[0035]  
[Effect of the Invention] The activity of the air (oxygen) pole of a solid-state polyelectrolyte type hydrogen-air (oxygen) fuel cell can be improved by this invention more sharply than the conventional thing, and a cell performance can be improved by leaps and bounds.

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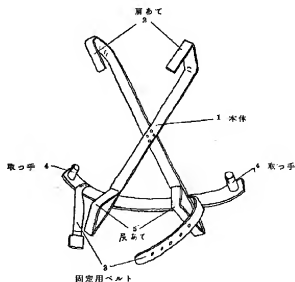
(54)【考案の名称】 スイング練習用 具

(57)【要約】

【目的】ゴルフスイングにおける、正しい体の動きを習得する用具を提供する。

【構成】お尻（ヒップトップ）と肩が斜めに離れるように（右肩と左尻 左肩と右尻）X字形に造った構造物

（1）の上部に肩と固定する部分（2）を取り付け下部に腰に固定するベルト（3）お尻に当たる突起部（4）取り外せる取っ手（5）を取り付けたことを特徴とするスイング練習用具。





【実用新案登録請求の範囲】

【請求項1】 お尻（ヒップトップ）と肩が斜めに継がるように（右肩と左尻 左肩と右尻）X字形に造った構造物（1）の上部に肩と固定する部分（2）を取り付け下部に腰に固定するベルト（3）をお尻に当たる突起部（4）取り外せる取っ手（5）を取り付けたスイング練習用具。

【図面の簡単な説明】

【図1】 本考案の斜視図である。

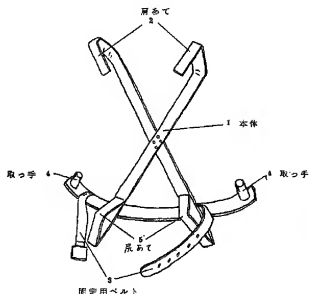
【図2】 本考案を体に付けた使用図である。①は、両手

で取っ手を腰に水平に右に廻した図である。②は、両手で取っ手を腰に水平に左に廻した図である。③は、使用例を後方から見た図である。

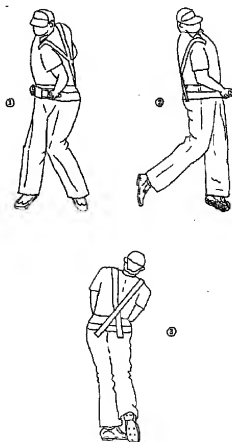
【符号の説明】

- 1 本体
- 2 肩あて
- 3 固定用ベルト
- 4 取っ手
- 5 尻あて

【図1】



【図2】



【考案の詳細な説明】

【０００１】

【産業上の利用分野】

この考案は、ゴルフスイングにおける正しい体の動きを習得する用具である。

【０００２】

【従来の技術】

ゴルフスイングにおける体の回転運動が、腰のみ、肩のみ、腰と肩のみでありお尻と肩、腰と肩と足の関係が習得できない。

【０００３】

【考案が解決しようとする課題】

- (イ) 肩の回転角度と腰の回転角度が正しく行われていない。
  - (ロ) 腰が回転しないで流れてしまっている。
  - (ハ) 腰と肩の回転の順番が逆になっている。
  - (ニ) 正しい体重移動をしていない。
  - (ホ) 腕を振って肩を廻すなど不自然な動きで、腰痛や関節を傷めている。
- 本考案は、これらの欠点を解決する為になされたものである。

【０００４】

【課題を解決するための手段】

X字型の本体（１）を、肩あて（２）と固定用ベルト（３）で体に固定する。

【０００５】

【作用】

前傾姿勢をとり、左右の手で左右の取っ手を握り、頭を動かさないようにして左方向と右方向に腰を廻す事により、肩と腰の回転と順番、体重移動を習得する。

【０００６】

【実施例】

以下、本案の実施例について説明する。

- (イ) ゴルフスイングが出来る服装をする。
- (ロ) 固定用ベルト（３）と肩あて（２）を用い尻あて（５）がヒップトップに

- (ハ) 前傾姿勢をとり、両脇を付けて左右の取っ手を握る。
- (ニ) 両手で取っ手(4)を腰に水平に右に廻す。
- (ホ) 両手で取っ手(4)を腰に水平に左に廻す。
- (ヘ) 足の動きを取り入れて左右の動きを繰り返す。

【0007】

ゴルフスイングが習得できない多くの理由は、正しい体の動きを覚えていない状態でゴルフクラブを腕で振っている為である。

つまり、全く逆の動きをしている。

本考案は、腰と両肩の運動した回転運動を簡単に習得できる。

本考案でいう腰とは、お尻（ヒップ・トップ）が中心となる。